CHAPTER 3

ELECTRONICS SAFETY

ELECTRIC SHOCK

Ninety-nine percent of what you do, you'll do around electricity. This makes you extremely susceptible to electric shock. It's very important for you to know these four things about electric shock:

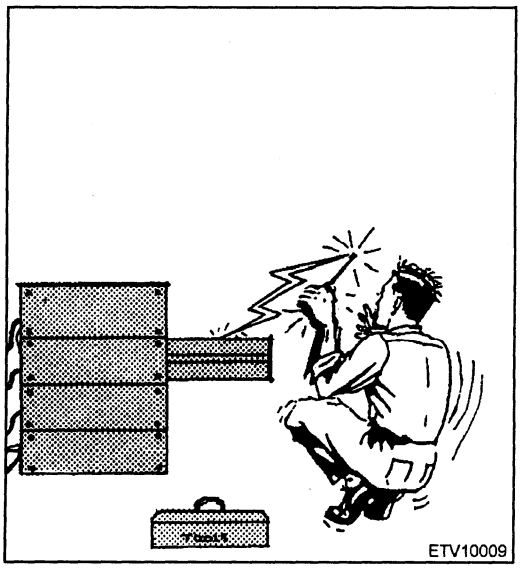
1. What it is.
2. What factors affect how severe it can be.
3. How to avoid it.
4. What to do if you see someone being shocked.

DEFINITION OF ELECTRIC SHOCK

Electric shock is the *sensation and muscular spasm caused* when electric **current** *passes through the body.* Note that the word *current* is bold in the last sentence. This is to emphasize that it is *current* and NOT the *voltage* that causes electric shock. No matter how much voltage is present, you'll only get shocked if you provide a ground-path for the electric current.

Here is an example taken from a mishap report:

> While trying to align the RF turret assembly of a high frequency transmitter, a Third Class Electronics Technician (ET3) received a shock from 1,000 volts of direct current (dc).
>
> While doing preventive maintenance, the technician discovered the high frequency (HF) transmitter did not meet the performance specifications required by the Maintenance Requirements Card (MRC) of the Planned Maintenance System (PMS). After trying to tune the transmitter using the front panel meter, the technician determined the turret assembly was faulty.
>
> The ET3 removed a high voltage insulation cover to get into the transmitter turret assembly adjustment fitting. While adjusting the turret, his thumb brushed a power amplifier tube plate connection. The 1,000 volts dc at the plate connection entered the ET3's thumb and forearm before finding its way to ground.
>
> The ET3 went to medical and the corpsman sent him to the naval hospital for evaluation and observation. The technician was released the next day.



SEVERITY OF ELECTRIC SHOCK

The following factors determine the severity of the effect electric shock has on your body:

- The amount of current that is flowing through your body.
- The path the current takes through your body.
- The amount of body resistance you have to the current flow.
- The length of time the current flows through your body.

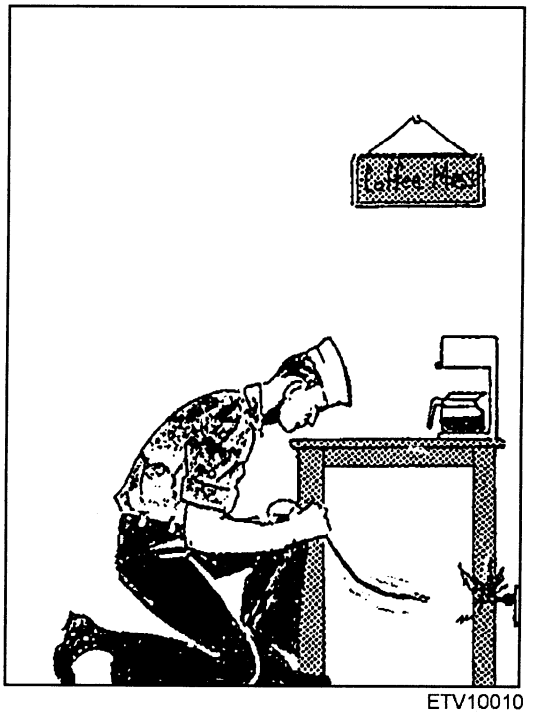
Path of Current Flow

The two most dangerous paths that current can take through your body are from (1) hand to hand, or (2) from

your left hand to either foot. The second path is the MOST dangerous path since the current will flow through both your heart and your vital organs.

Amount of Body Resistance

Your body resistance varies greatly in different parts of your body. A value of 1500 ohms is commonly used as the resistance between major extremities of an average human body: hand to hand, or hand to foot. Let's use Ohm's Law to figure how much current would flow through your body if you accidentally grabbed a wire carrying 120 volts alternating current (vac).



ETV10010

Ohm's Law for figuring current is $I = E/R$.

Let E = 120 VAC—The voltage you grabbed

Let R = 1500 Ohms—Your (average) body resistance

Now let's compute it.

I = 120/1500

I = .080

I = 80 milliamperes

So if you grabbed a 120-vac wire, 80 milliamperes of current would flow through your body. Now use table 3–1 to determine the effect of 80 milliamperes of electric shock. You can see that you may not be around long enough to grab any more wires. You grabbed 80 milliamps of current! That's 15 milliamps beyond what could be fatal. It's also 70 milliamps beyond the *can't-let-go* threshold, and 62 milliamps beyond what is needed to cause you to stop breathing.

Table 3-1.—Electric Shock Effects

HUMAN REACTION (at 60Hz)	CURRENT (milliamperes)
PERCEPTION—A slight tingling sensation	1.1
CAN'T LET GO—Arm and hand muscles close involuntarily (120 lb. person)	10.0
CAN'T LET GO—(175-lb. person)	16.0
CAN'T BREATHE—Paralysis of the chest muscles	18.0
HEART FIBRILLATION—Rapid irregular contractions of the heart muscles-could be fatal.	65.0

It's important to remember that the 1500 ohms is just an average value. Body resistance varies from person to person and may often be LESS than 1500 ohms. When your skin is moist, your body resistance could be as low as 300 ohms. Also, breaks in your skin at the point of contact reduce your skin resistance to nearly zero.

Skin resistance is only important when you're handling voltages of less than 240 volts. If you get shocked by more than 240 volts, the voltage arc will burn through your skin and leave deep third-degree bums where it enters your body.

Time of Current Flow

The longer you're being shocked, the more chance there is for your heart to begin fibrillation. Fibrillation is the shocking of your heart into a useless flutter. Most people who die from electric shock die from fibrillation. Fibrillation in a normal adult is unlikely if the current in milliamperes is less than 116/t, where t is the shock duration in seconds. The longer you are shocked, the less current is needed to cause heart fibrillation. Here are some examples of shock current levels and durations that would cause fibrillation:

- 21 milliamperes for 30 seconds
- 44 milliamperes for 7 seconds

- 67 milliamperes for 3 seconds

AVOIDING ELECTRIC SHOCK

The three basic ways to prevent yourself from receiving an electric shock can be summed up in three words: *isolate, insulate,* and *ground.*

1. **Isolate:** Isolate yourself from the source of electric shock. Make sure you secure the power to equipment before you attempt to remove it. And, make sure all electrical equipment covers, doors, and enclosures are kept in place when you're not *actually* working on the equipment. If you must leave live circuitry exposed, rope off the area, post appropriate signs, and warn your fellow workers of the danger.

2. **Insulate:** Make sure the electrical tools and equipment you use are properly insulated. Use only insulated hand and portable electric power tools. Frequently check power and extension cords for deterioration, cracks, or breaks. Breaks in the insulation of power and extension cords cause many electrical mishaps.

3. **Ground:** Electric current always follows the path of least resistance. To prevent yourself from being the unintentional path to ground, make sure your equipment is well grounded. This will direct any stray electric current to ground, thereby protecting you from electric shock. A good ground could also protect your equipment from excessive voltage spikes or lightning. For further information on equipment grounding, see *Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility and Safety,* MIL-STD-1310 (NAVY).

RESCUING VICTIMS OF ELECTRIC SHOCK

The first thing to do when you see someone being shocked is to secure the power. DO NOT touch a victim who is in contact with a live circuit, or you'll be shocked too. If you cannot secure the power, use a dry insulating material like a rope, a belt (without the buckle), or a wooden cane to remove the victim (by pulling, pushing, or rolling) from the live circuit or wire. Then, immediately call for medical personnel.

If the victim is unconscious **AND** *you are certified* to administer cardiopulmonary resuscitation (CPR), begin to do so.

The effects of the electric shock can range from mild surprise to death. It depends on the amount of current, voltage, and the duration of the electric shock. It's hard to know exactly how a victim of electric shock has been affected. More than likely, the victim will be very pale or bluish in color and unconscious.

MEASURING VOLTAGE ON ENERGIZED EQUIPMENT

As an ET, you'll work on energized equipment. You will be troubleshooting a piece of electrical or electronic equipment, and the technical manual will instruct you to measure voltages or to check signal waveforms while the equipment is energized. But, before you hook up the multimeter or oscilloscope, there are certain safety precautions and procedures you MUST follow. They're designed to protect you from electric shock. These precautions and procedures are divided into two basic categories: (1) voltage measurements below 300 volts, and (2) voltage measurements above 300 volts.

MEASURING VOLTAGE BELOW 300 VOLTS

Most of the voltage measurements that you will make will be below 300 volts. Almost all of the newer electronic systems use voltages that are less than 28 volts, except for the main input ac power. Here are some safety procedures you should follow when you need to measure voltages below 300 volts:

1. Notify and obtain permission from the commanding officer (afloat) or your supervisor (ashore) to work on energized equipment. Some commands require you to complete a checklist before doing this.

2. Study the schematic and wiring diagrams of the equipment on which you'll be working. Note the location of the points you will be measuring and, also, the location of any other high-voltage points you should be careful not to measure or touch.

3. Remove all metal watches, belt buckles, rings (even wedding bands), and any other items that have exposed metal. If you're wearing a security badge, put it in your pocket.

4. Make sure you're wearing electrical safety shoes, if they were issued, and that you're standing on insulating rubber matting. If you must insert your hand into the enclosure of the energized equipment, wear a

Table 3-2.—Rubber Gloves

Class	Maximum Safe Voltage
0	750 volts
I	3000 volts
II	4000 volts
III	5000 volts

pair of electrical safety rubber gloves rated for the appropriate voltage (see table 3-2).

5. Have a co-worker stand by; don't work alone. Make sure your co-worker knows where to secure the power in case of emergency.

Follow these four safety precautions **whenever** you take measurements on energized equipment:

1. Always use test probes with safety guards or barriers on the probe tips. This will prevent your hand from in advertently touching the probe tip.

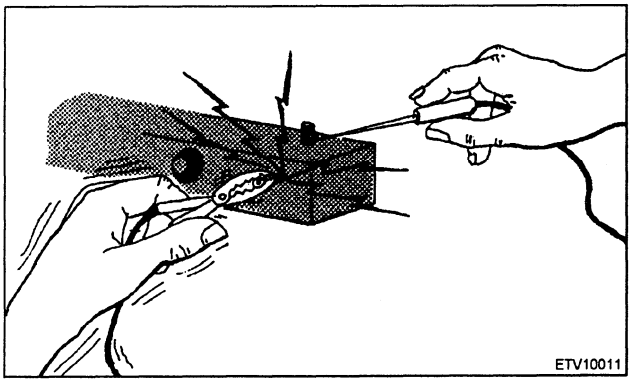
2. Always used insulated alligator clips.

3. Always keep your body clear of any metal parts of the equipment on which you're working.

4. Try and keep one hand in your pocket or behind your back when taking the measurement. This will prevent you from creating a ground path for electric current flow through your body from hand to hand.

Here is an excerpt from a mishap report that will show the importance of following the above precautions:

> Member could not get alligator clip on test lead to stay on probe so he held clip to probe with right hand. Member violated safety precautions by continuing to hold clip and probe while energizing the test lead with 1200 volts. Soon thereafter, the member touched the ground lead and received serious shock. The member was treated for minor burns on the palm.



MEASURING VOLTAGE ABOVE 300 VOLTS

All the safety procedures for measuring voltages **below** 300 volts apply when you are measuring voltages **above** 300 volts. But, the big difference when measuring voltages above 300 volts is that you must **NOT** hold the test probe in your hand while the equipment is energized. Instead, you'll attach the test probes while the equipment is de-energized. Here are the safety procedures you should follow:

1. Follow all the preliminary safety procedures for measuring voltage **below** 300 volts before beginning your measurements.
2. Make sure the equipment you are working on is DE-ENERGIZED. Follow the required tag-out procedures.
3. With a shorting probe, discharge all high-voltage capacitors.
4. Attach the ground probe of the measuring device **first.**
5. Secure the other probe of the measuring device to the test point to be measured.
6. Make sure the measuring device is setup for the voltage level and polarity to be measured.
7. Energize the equipment under test, make the measurement, and then de-energize the equipment.
8. Discharge all high-voltage capacitors.
9. Remove the probes from the equipment.

ELECTROSTATIC DISCHARGE PRECAUTIONS

Electrostatic discharge (ESD) can destroy or damage many electronic components including integrated circuits (ICs) and discrete semiconductor devices. Certain devices are more susceptible to ESD damage than others. Because of this, warning symbols are now used to identify ESD-sensitive (ESDS) items (fig. 3–1).

Certified 2M technicians are trained in procedures for reducing the causes of ESD damage. The procedures are similar for all levels of maintenance. Some of the protective measures you should follow to prevent ESD damage are:

- Ground the work benches where ESDS devices will be handled.

Figure 3-1.—Warning symbols for ESDS devices

- Be sure you are grounded.
- Check packaging and equipment technical manuals for ESD warnings and instructions.
- Before opening an electrostatic unit package of an ESDS device or assembly, ground the package.
- Minimize the handling of ESDS devices or as semblies.
- Avoid unnecessary physical movement.
- When removing or replacing an ESDS device or assembly in the equipment, hold the device or assembly through the electrostatic free wrap if possible.
- Do not permit ESDS devices or assemblies to come in contact with ungrounded materials.
- When moving an ESDS device or assembly, always touch (with bare skin) the surface on which it rests for at least one second before picking it up.
- When servicing ESDS devices, do not touch or handle materials that create static charges, or, be sure to repeat the grounding action.
- When possible, avoid repairs that require soldering at the equipment level.
- Ground the leads of test equipment before energizing test equipment and before probing ESDS items.

Remember, although many sources of electrostatic charge are of little consequence during most daily activities, they become extremely important when you work with ESD material. For further information, refer

to NEETS, Module 14, *Introduction to Microelectronics.*

ELECTROMAGNETIC RADIATION HAZARDS

The electromagnetic spectrum encompasses everyday-use items from commercial power to medical x-rays, as shown in figure 3-2. In this area we will discuss radio frequency radiation and optical radiation.

R-F HAZARDS TO PERSONNEL

Radiation from antennas fed by high powered rf transmitters has the potential for injuring personnel who happen to be near the radiating antennas. Transmitters aboard ships, on aircraft, at shore stations, and microwave ovens found both aboard ships and ashore are potential sources of harmful radiation. At some frequencies, exposure to excessive levels of rf radiation will not produce a noticeable sensation of pain or discomfort to give warning that injury may be occurring. Radiated rf energy can also result in rf burns when metal objects with induced high rf voltage levels are touched.

An rf burn is the result of current flowing through the body when parts of the body are in contact with rf voltages induced in conductive objects. The current produces heat as it passes through the resistance of the skin. The effect of the heat on a person ranges from warmth to painful burns.

LASER HAZARDS TO PERSONNEL

The word *laser is* an acronym for Light Amplification by Stimulated Emission of Radiation. A laser is basically a concentrated beam of optical radiation. As technology increases, the use of laser equipment will increase for purposes ranging from industrial to medical to military (both offensive and defensive).

The effects that lasers can have on your eyes range from inflammation of the cornea to corneal burn and on your skin from accelerated skin aging to skin burn.

If you are involved with the use of lasers at your command, be sure to follow all safety precautions for the class of laser in use and all directions given to you by your command's Laser Safety Officer. Lasers will be discussed in greater detail in volume 9 of this series.

We recommend that you become familiar with the contents of NAVSEA OP 3565/NAVAIR 16-1-529, Technical Manual, *Electromagnetic Radiation Hazards (U), (Hazards to Personnel, Fuel, and Other Flammable Material) (U).* We also recommend that you

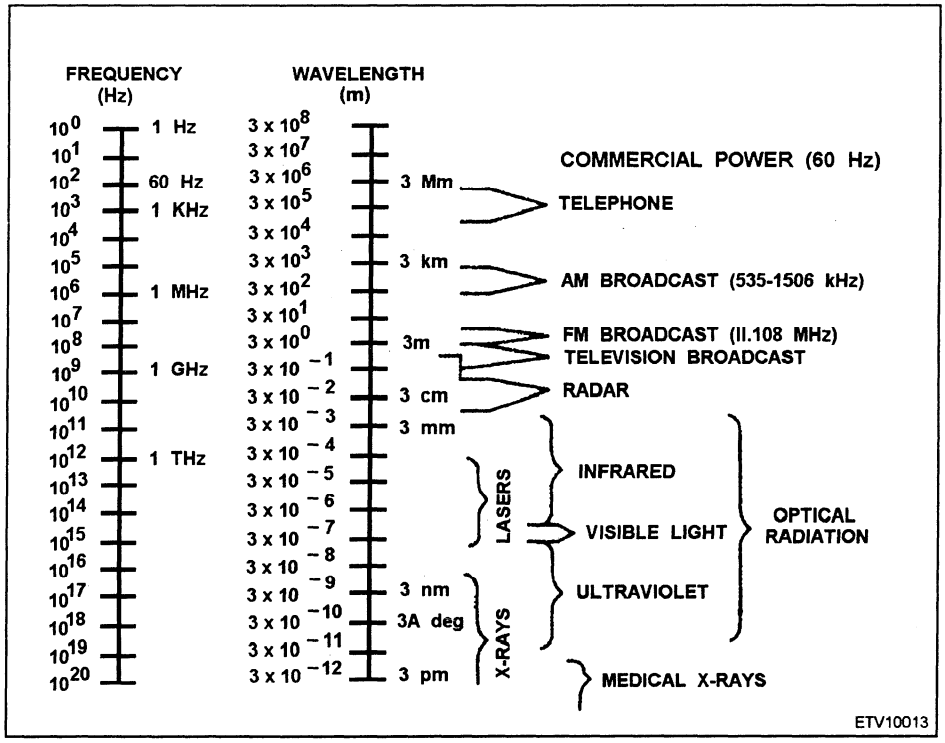


Figure 3-2.—Electromagnetic spectrum.

read chapter 22 of the *Navy Occupational Safety and Health (NAVOSH) Program Manual,* (OPNAVINST 5100.23) for shore operations, and chapter B9 of the *NAVOSH Program Manual for Forces Afloat* (OPNAVINST 5100.19).

TAG-OUT BILL

The tag-out bill is a system of documents used to save lives and to prevent unnecessary damage to equipment. It uses *CAUTION* tags and *DANGER* tags, *out-of-calibration* labels, and *out-of-commission* labels to let you know when a specific switch, circuit breaker, piece of equipment, electronic system, or plumbing valve should be either operated with extra care or completely left alone.

As an ET, you won't be securing many plumbing valves. But, you will be securing a **lot** of power switches and circuit breakers to do preventive and corrective maintenance on electronic systems and equipments. It's not possible in this topic to identify all situations requiring tag-out. However, here are a few situations that **do** require you to tag out the equipment:

Working Aloft or Over the Side: Since many areas on the exterior of a ship are inaccessible from decks or built-in work platforms, it becomes necessary to go aloft or over the side to reach these areas.

The greatest hazard associated with working aloft or over the side is the danger of a fall. Other hazards include the dropping of objects on (or by) personnel, radiation burns, and asphyxiation. When working aloft, the following must be observed:

- Do not go aloft on masts, maces, stacks, or king posts or be suspended over the side by a crane without first obtaining written permission from the O.O.D. in the form of a working aloft checklist.

- Wear supplied air respirators when working near stacks or exhaust which are actively discharging gases.

- Use a climber sleeve assembly in conjunction with the safety harness when going aloft where a climber safety rail is installed.

- Before commencement of work and every 15 minutes thereafter, pass a verbal warning over the 1 MC, DO NOT ROTATE ANTENNAS, ENERGIZE OR RADIATE ANY ELECTRICAL OR ELECTRONIC EQUIPMENT WHILE PERSONNEL ARE WORKING ALOFT. If personnel aloft are in the vicinity of the stacks add, **DO NOT BLOW TUBES OR LIFT SAFETY VALVES WHILE PERSONNEL ARE WORKING ALOFT.**

- Inform ships in the vicinity that personnel will be working aloft to ensure they take appropriate action on operation of electrical or electronic equipment.

- Departments concerned shall ensure that all radio transmitters and radars that pose radiation hazards are placed in the STANDBY position and a sign placed on the equipment that reads:

SECURED PERSONNEL ALOFT
DATE _____ TIME _____ INITIALS _____

- Position a safety observer on deck near the work being performed. Outfit the safety observer with a safety harness, lanyards, and climber safety sleeve to permit rapid emergency assistance aloft if required. The safety observer shall keep the deck area beneath the work aloft free of unnecessary personnel.

Now, refer to *Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat,* (OPNAVINST 5100.19), and read Chapter C8. Then return to this manual.

Corrective Maintenance: When you're working on equipment that must have its power secured, and there's a chance someone else could inadvertently reapply power while you are still working on it.

Preventive Maintenance: When planned maintenance system (PMS) maintenance requirement cards (MRCs) or equipment technical manuals direct you to secure electrical power.

Danger Exists: When you are operating an equipment that could endanger someone's life. This could apply to both mechanical and electrical faults.

TAG-OUT RESPONSIBILITIES

Commanding officers are responsible for the well-being of their people and the operational readiness of their equipments. They are ultimately responsible for making sure their personnel follow the appropriate tag-out procedures. To help do this, they assign *authorizing officers* who have authority to sign, issue, and clear tags and labels. There is usually one authorizing officer for each department. The authorizing officer can be a commissioned officer, chief petty officer, or petty officer. When the affected system will be rendered out-of-commission as a result of the tag out action, the Authorizing Officer shall obtain permission of the CO when appropriate and the cognizant Department Head

before effecting the tag-out. In addition, the Authorizing Officer shall notify the cognizant Division Officer of the requirement for the tag-out.

Your department's authorizing officer will:

- Make sure you are qualified to do the work you are about to do.
- Maintain the tag-out log(s).
- Sign and issue tag(s) and tag-out record sheet(s).
- Clear the record sheet(s) from the tag-out log(s) and destroy the tag(s) when the work is completed.

TAG-OUT DOCUMENTS

Tag-out documents consist of:

- A tag-out log
- CAUTION Tags (NAVSHIPS 9890/5) (yellow)
- DANGER Tags (NAVSHIPS 9890/8) (red)
- Out-of-Calibration Labels (NAVSEA 92 10/6)
- Out-of-Commission Labels (NAVSHIPS 9890/7)

We will discuss the first three items in depth. The last two items are labels used to identify test equipment that is either out of calibration or out of commission.

Tag-Out Log

A tag-out log is a permanent log of the authorizations given for all tag-out actions. It's kept in a three-ring binder and has five sections that contain the following:

Section 1. A copy of the *Equipment Tag-Out Bill*, chapter 6, OPNAVINST 3120.32; and a copy of the command's *amplifying* instruction on equipment tag-out.

Section 2. DANGER/CAUTION Tag-Out Index and Record of Audits (OPNAV 3120/4). (See figure 3–3.) The authorizing officer uses this form to assign and track all of the issued DANGER/CAUTION tags.

Note that the blocks on figure 3-3 are labeled (A) through (E). Here is an explanation of each block:

(A) LOG SERIAL: The sequential log serial number issued for tag-out actions.

(B) DATE ISSUE: The date the log serial number was issued.

(C) TYPE: The type of tags used, either DANGER or CAUTION.

(D) DESCRIPTION: A description of the system or component that will be tagged-out and any amplifying information.

(E) DATE CLEARED: The date that ALL the tags were cleared.

Section 3. DANGER/CAUTION Tag-out record sheets (NAVSEA 9210/9) that are still in effect. Figures 3-4 and 3-5 show the front and back sides of this form.

Note that the items on the form are labeled (A) through (R). When you tag out equipment, you must complete items (A) through (J) and item (M) on the form. Here's an item-by-item explanation of the form:

(A) DATE/TIME TAG-OUT ISSUED: Enter the date and time the authorizing officer issued

DANGER/CAUTION TAG-OUT INDEX AND RECORD OF AUDITS

LOG SERIAL	DATE ISSUE	TYPE (DANGER/CAUTION)	DESCRIPTION (SYSTEM, COMPONENT, WORK PERMIT OR TEST DOCUMENT REFERENCE)	DATE CLEARED
(A)	(B)	(C)	(D)	(E)

OPNAV 3120/4 (10-85)

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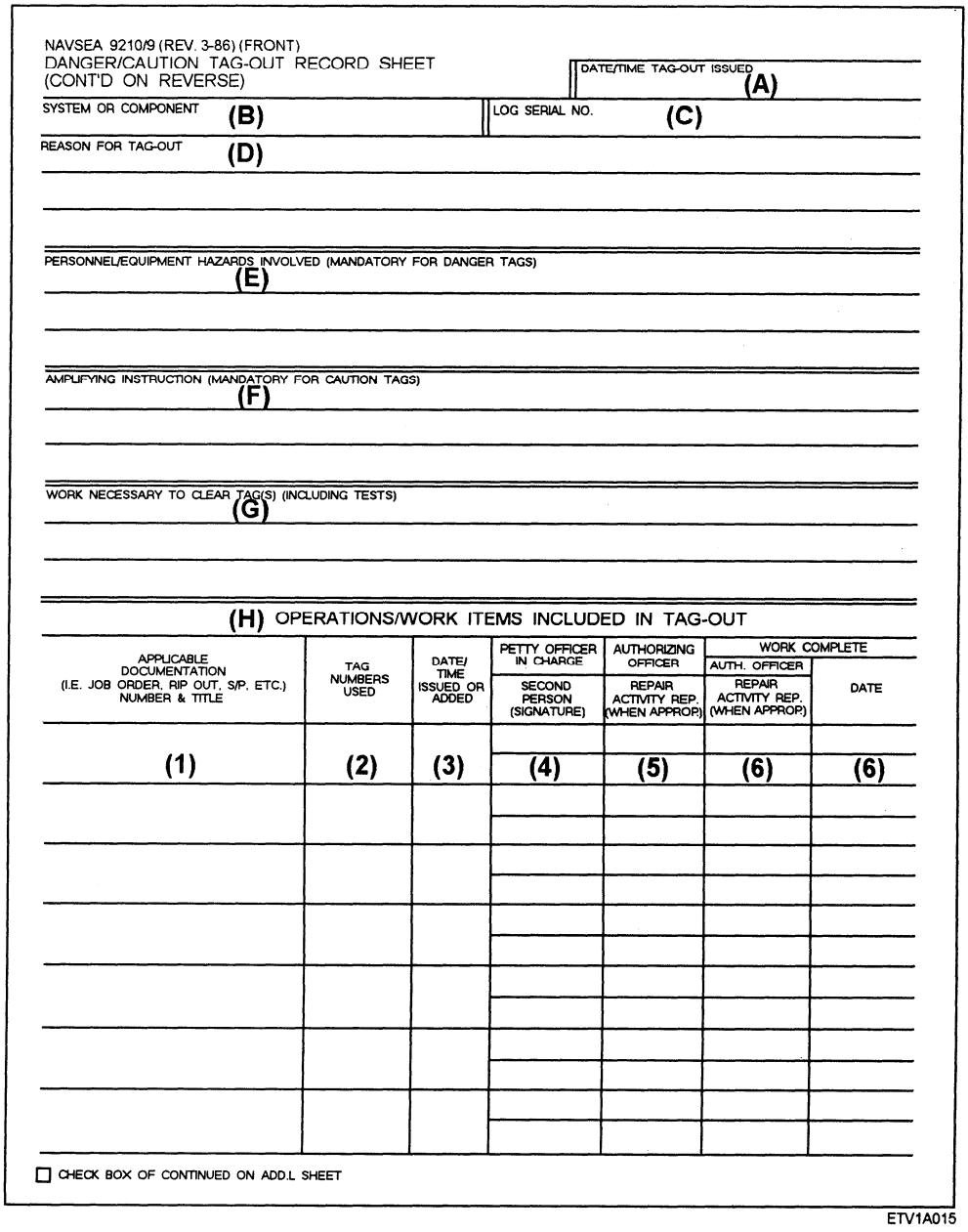
Figure 3-3.—DANGER/CAUTION Tag-Out Index and Record of Audits (OPNAV 3120/4).



NAVSEA 9210/9 (REV. 3-86) (FRONT)
DANGER/CAUTION TAG-OUT RECORD SHEET
(CONT'D ON REVERSE)

DATE/TIME TAG-OUT ISSUED (A)

SYSTEM OR COMPONENT (B)

LOG SERIAL NO. (C)

REASON FOR TAG-OUT (D)

PERSONNEL/EQUIPMENT HAZARDS INVOLVED (MANDATORY FOR DANGER TAGS) (E)

AMPLIFYING INSTRUCTION (MANDATORY FOR CAUTION TAGS) (F)

WORK NECESSARY TO CLEAR TAG(S) (INCLUDING TESTS) (G)

(H) OPERATIONS/WORK ITEMS INCLUDED IN TAG-OUT

APPLICABLE DOCUMENTATION (I.E. JOB ORDER, RIP OUT, S/P, ETC.) NUMBER & TITLE	TAG NUMBERS USED	DATE/ TIME ISSUED OR ADDED	PETTY OFFICER IN CHARGE	AUTHORIZING OFFICER	WORK COMPLETE	
					AUTH. OFFICER	
			SECOND PERSON (SIGNATURE)	REPAIR ACTIVITY REP. (WHEN APPROP.)	REPAIR ACTIVITY REP. (WHEN APPROP.)	DATE
(1)	(2)	(3)	(4)	(5)	(6)	(6)

☐ CHECK BOX OF CONTINUED ON ADD.L SHEET

ETV1A015

Figure 3-4.—DANGER/CAUTION Tag-Out Record Sheet NAVSEA 9210/9 (Front).

you a log serial number from the DANGER CAUTION Tag-Out Index and Record of Audit sheet.

(B) SYSTEM OR COMPONENT: Enter the official nomenclature of the system or equipment you are tagging-out (example, AN/WSC-3[V]).

(C) LOG SERIAL NO.: Enter the number assigned by the authorizing officer.

(D) REASON FOR TAG-OUT: Briefly describe the reason for the tag-out (example, "Preventive maintenance").

(E) PERSONNEL/EQUIPMENT HAZARDS INVOLVED: Briefly describe any hazards that may exist (examples, "Shock hazard" or "Operation would damage equipment").

(F) AMPLIFYING INSTRUCTIONS: Briefly describe any other instructions that may apply.

DANGER/CAUTION TAG-OUT RECORD SHEET
NAVSEA 9210/9 (REV 3-86) (BACK)

TAG NO.	LOCATION	TAGGED POSITION/ CONDITION	POSTED BY (INITIAL)	POSTING CHECKED BY (INITIAL)	CLEARANCE/ POSITION/ CONDITION	CLEARANCE AUTHORIZED (SIGNATURE) (O)		DATE/ TIME CLEARED	CLEARED BY (INITIAL)
						AUTHORIZING OFFICER	REPAIR ACTIVITY		
(I)	(J)	(K)	(L)	(M)	(N)			(P)	(Q)

SIGNATURE OF WATCH OFFICER/DUTY OFFICER	DATE/TIME	
(R)	(R)	☐ CONTINUED AS ADDT'L SHEET (CHECK BOX IF APPLICABLE)

ETV1B0015

Figure 3-5.—DANGER/CAUTION Tag-Out Record Sheet NAVSEA 9210/9 (Back).

(G) WORK NECESSARY TO CLEAR TAG(S): Briefly describe any work that must be done before the tag(s) can be cleared.

(H) OPERATIONS/WORK ITEMS INCLUDED IN TAG-OUT: Fill in this part of the form as follows:

1. List the jobs to which this tag-out applies. If the tag-out is for an outside repair activity, list the job order number and title.

2. Record the tag numbers used and the date and time they were issued.

3. You, as the "petty officer in charge," sign in the designated block. Then have a second person sign after he or she verifies that (1) you are using the right type and number of tags, and (2) you are tagging out the correct item.

   Only qualified ship's force personnel shall perform the second check of tag installation. The second person shall not accompany the person initially installing the tag(s).

4. Next, have the authorizing officer and the repair activity representative, if applicable, sign in the spaces provided.

5. After the work is completed and the tag-out tags are removed, have the authorizing

officer and the repair activity representative, if applicable, certify the work completed and the tags cleared by signing and dating in the blocks provided.

(I) TAG NO. (back side of form): List each tag separately. An example tag number is "76-3. " The "76" is the issue log serial number. The "-3" indicates that the tag is the third one used.

(J) LOCATION: Be specific. Give the power panel identification number and breaker identification number. If the tag-out action is on board a ship or submarine, also give the frame number. If the action is ashore, also give the building and room number.

(K) TAGGED POSITION/CONDITION: State the position in which the tagged item should remain (examples; ON, OFF, OPEN, or CLOSED).

(L) POSTED BY (INITIAL): The person who actually hangs the tag, initials here.

(M) POSTING CHECKED BY: A second person, after checking to make sure the tag was attached correctly, initials here.

(N) CLEARANCE/POSITION/CONDITION: State the position each tagged item should be in when the tag is cleared.

(O) CLEARANCE AUTHORIZED: After you've completed the work, the authorizing officer and the outside repair activity authorize you, by signing here, to clear the tags.

(P) DATE/TIME CLEARED: The person who removes the tag enters the date and time the tag is removed.

(Q) CLEARED BY: The person who removes the tag initials here.

(R) SIGNATURE OF WATCH OFFICER/DUTY OFFICER and DATE/TIME: The authorizing officer signs and dates the form here to certify that all switches, circuit breakers, etc., are returned to their normal operating position/ condition.

Section 4: Instrument Log (NAVSHIPS 9890/10). This log is the record of all of the out-of-commission and out-of-calibration labels issued.

Section 5: DANGER/CAUTION Tag-out Record Sheets that have been cleared and are no longer in effect.

CAUTION Tags (NAVSHIPS 9890/5)

A CAUTION tag is a **yellow-colored** tag used only as a *precautionary measure* to give temporary **special** instructions, or to indicate that unusual caution must be exercised when operating the equipment to which the tag is attached (fig. 3-6).

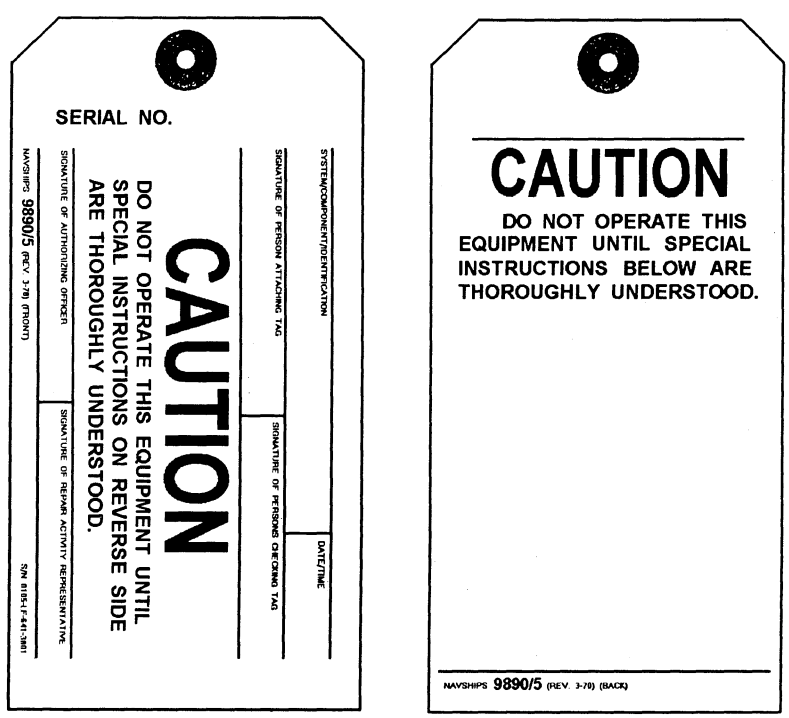


Figure 3-6.—CAUTION Tag (yellow in color).

The instructions you write on the tag must state the specific reason the tag was attached. Do not use a CAUTION tag if there is a chance someone could be hurt or equipment could be damaged when operated using normal operating procedures. Use a DANGER tag instead.

DANGER Tag (NAVSHIPS 9890/8)

A DANGER tag is a **red** -colored tag used to prohibit operation of equipment that, if operated, could jeopardize the safety of personnel or damage equipment. Under **NO** circumstances may equipment be operated or removed when tagged with a DANGER tag (fig. 3-7).

TAG-OUT PROCEDURES

Before you tag out apiece of equipment, make sure you get your supervisor's permission. If the equipment is mission-critical, you may even need your division officer or department head's permission to tag out the equipment.

Now go to the *Standard Organization and Regulations of the U.S. Navy,* (OPNAVINST 3120.32), and read chapter 6, section 630.17.6, "Standard Tag-Out Procedures," and return to this manual.

PROTECTIVE EQUIPMENT

Wearing the correct protective equipment is essential to all persons in the Navy. It is especially important for the safety of electronics personnel. In the following paragraphs, we will discuss this equipment.

ELECTRICAL SAFETY SHOES

You may be issued a pair of electrical safety shoes when you report to your first duty station. You **should** wear them whenever you work on or around energized equipment for your own safety.

Take care of your electrical safety shoes. You can clean and shine them just like regular safety shoes. And when they become worn out or damaged, turn them into your supply petty officer for a new pair.

Electrical safety shoes do not have any exposed metal parts like you might find on regular safety shoes. They do have special non-conducting soles designed to protect you from electric shock. The soles are rated to insulate you from a maximum of 600 volts.

Electrical safety shoes are stocked in the Naval Supply System under the National Stock Number (NSN) 8430-00-611-XXXX. The "XXXX" part of the NSN specifies the shoe size.

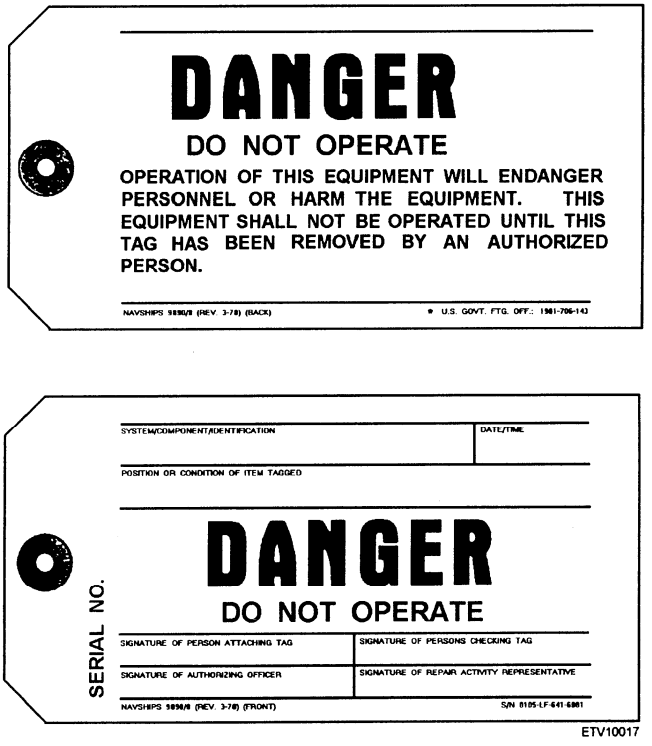


Figure 3-7.—DANGER Tag (red in color).

RUBBER GLOVES

There are four classes of rubber insulating gloves, the primary features being the wall thickness of the gloves and their maximum safe voltage rating. The classes and the maximum safe voltage for which the gloves can be used are listed in table 3-2.

Class 0 gloves are available in half-sizes from size 9 through size 12.

SAFETY SHORTING PROBE

Some of the electronic equipment you'll work on will use large capacitors to filter the electrical power. You **must** discharge these capacitors before you can begin any work on the equipment. To do this you will need to get a safety shorting probe and follow these procedures:

1. Make sure input power to the equipment has been secured. Use the appropriate tag-out procedures, if necessary.

2. Open the equipment to gain access to the capacitors that need to be discharged. **BE CAREFUL** not to touch any exposed terminals. Large filter capacitors can store a lot of energy. And if you touch the exposed terminals. . . **.ZAP!!**

3. Connect the flexible ground strap of the safety shorting probe to the metal chassis of the equipment. Make sure there is a good metal-to-metal connection.

4. While holding the safety shorting probe by its plastic handle, touch the metal probe tip to the appropriate terminals to be grounded. BE CAREFUL not to touch the metal probe tip or the flexible ground strap while the probe is in contact with the terminals of the capacitor. Repeat this step two or three times to ensure the capacitor is completely discharged.

Approved safety shorting probes are stocked by the Naval Stock System.

EYE PROTECTION

As an Electronics Technician, you depend heavily on your sense of sight in performing your job. To help protect your eyesight, you should know (1) when to wear eye protection, and (2) which eye protection to wear.

The *Navy Occupational Safety and Health (NAVOSH) Program Manual* (OPNAVINST 5100.23), states that you are **required to wear appropriate eye protective equipment when performing eye hazardous operations.** In other words, whenever you're doing something that could damage your eyes, **WEAR EYE PROTECTION.** Some of the things you'll do that fall into this category are:

- Using an electric drill
- Soldering
- Maintaining batteries
- Cleaning and maintaining equipment using hazardous materials

Here are a few things to remember about eye protection:

- Eye protection isn't an option; it's a requirement. If you're doing something that calls for eye protection, take the time to get it and wear it. You can replace a scratched pair of goggles, but you can't replace a scratched eye.

- Wear eye protection even when you are just "walking around" hazardous activities.

- After you are through using eye protection equipment, clean it and store it properly.

HEARING PROTECTION

Hearing loss is a problem in the Navy. Every day, you'll be working with and around many noisy equipments and machinery that could damage your hearing. And, in most cases, the damage won't happen overnight; it will happen slowly. Your hearing will degrade until you will not be able to hear the softer sounds as well as you could have if you'd worn hearing protection. This is commonly called a *hearing threshold shift.* It simply means that **the more** you are exposed to damaging levels of noise, **the louder** normal sounds must be for you to hear them.

You must start NOW to protect yourself from hearing loss. OPNAVINST 5100.23 states that **"hearing protective devices shall be worn by all personnel when they must enter or work in an area where the operations generate noise levels of greater than 84 decibels."**

RESPIRATORY PROTECTION

Recall from chapter 2 the discussion of hazardous paints, solvents, and other materials associated with the cleaning and maintenance of electronic equipment and antennas. We cannot emphasize too strongly the importance of using the proper respiratory protection

when you use these materials. Be **sure** to ask your supervisor about the need for respiratory protection whenever you:

- Chip lead or chromate based paints while removing corrosion.
- Prime and paint the bases of antennas.
- Clean circuits with spray solvents and alcohol.

Whenever you perform these operations, be sure the work area has good ventilation. This will help prevent you from inhaling hazardous vapors and dusts.

DECK INSULATING MATERIAL

Your working environment should have deck insulating material (more commonly called *rubber matting)* to protect you and your shipmates from electric shock. It must be installed wherever work is done on energized electrical and electronic equipment, This includes electronic repair shops that have workbenches to work on electronic equipment.

The rubber matting should be rated for use in areas where the maximum voltage won't exceed 3000 volts. It must be installed in one continuous run, at least 36" wide, and must extend at least 24" past each end of the workbench. If you must work on energized equipment located in an area where rubber matting is not installed, protect yourself from electrical shock by using a 6-foot piece of rubber matting as a portable safety deck. When you're done, roll it up and store it for the next job.

Rubber matting does a great job of protecting you from electric shock. But, it won't do it for long if you don't take care of it. Here area couple of tips for keeping the insulating properties of rubber matting intact:

1. Always keep rubber matting clean and free of any excess dirt, oils, or oil-based products. When you clean rubber matting, **don't** use any abrasive cleaners or electric buffers. If you do, you will ruin its insulating effectiveness.

2. Periodically inspect the rubber matting for cuts, cracks, or excessive wear. If you notice any of these conditions, replace the entire piece of rubber matting.

Throughout this volume we have discussed safety issues that are important to Electronics Technicians. Now, you must take this knowledge and apply it to your everyday job. Remember, **SAFETY FIRST.**